

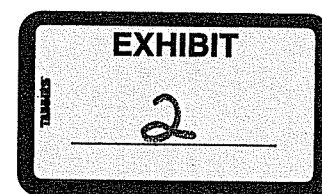
COMPREHENSIVE BASIN MANAGEMENT PLAN

FOR THE ILLINOIS RIVER BASIN

IN OKLAHOMA

Prepared by

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EXECUTIVE SUMMARY

The Illinois River Watershed (including Lake Tenkiller) in northeastern Oklahoma is one of the State's most valuable and controversial watersheds. Considerable effort has focused on studying the watershed to identify problems, causes, and potential solutions. These studies have concentrated primarily on water quality (both in the river and lake), land use, and the relationship between the two.

This report attempts to summarize the main historical research on water resources in the basin and then summarize what various government agencies have done or plan to do to remediate problems in the watershed. Many steps have already been taken to reduce pollution in the watershed; however, significant sources must still be addressed to protect the river and Lake Tenkiller.

The watershed extends from Northwestern Arkansas (Benton, Washington, and Crawford Counties) to Northeastern Oklahoma (Delaware, Adair, Cherokee, and Sequoyah Counties)(**Figure A**). Arkansas has developed their own plan to address water quality problems in the river and this report will outline a similar plan for Oklahoma. As such, this report will only address the Illinois River Watershed (including Lake Tenkiller) in Oklahoma.

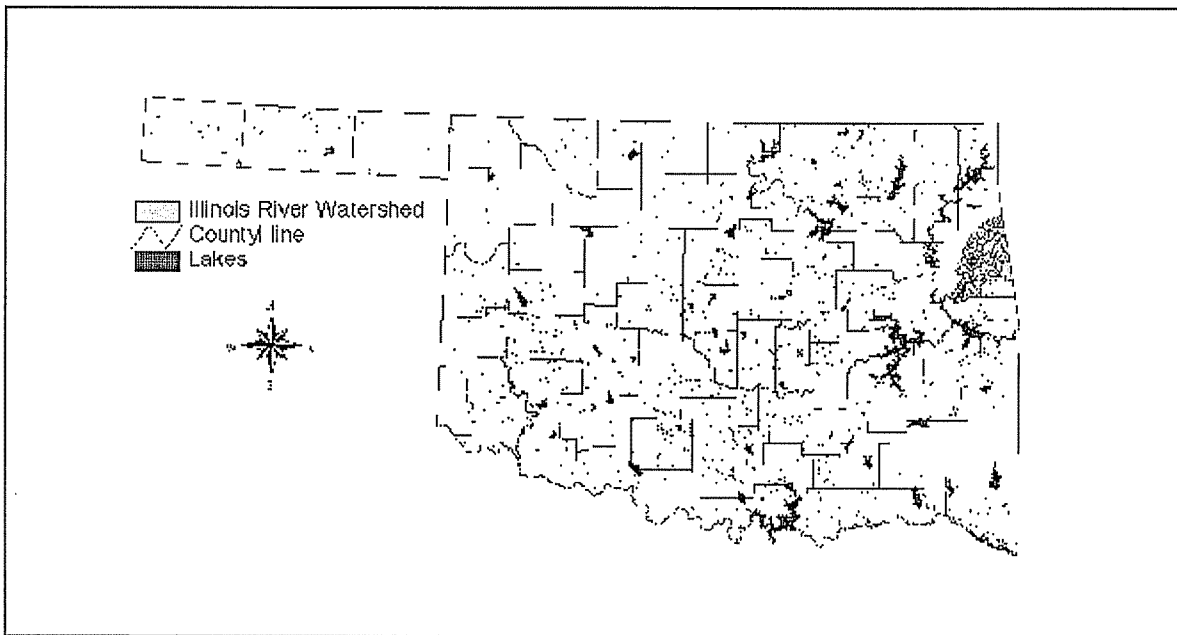


Figure A. Location of the Illinois River Watershed in Oklahoma.

Much of the initial investigation into the water quality of the basin was due to the perception by local citizens that water clarity had declined in the river, its tributaries, and in Lake Tenkiller (**Figure B**). Research was necessary to determine whether this perception was

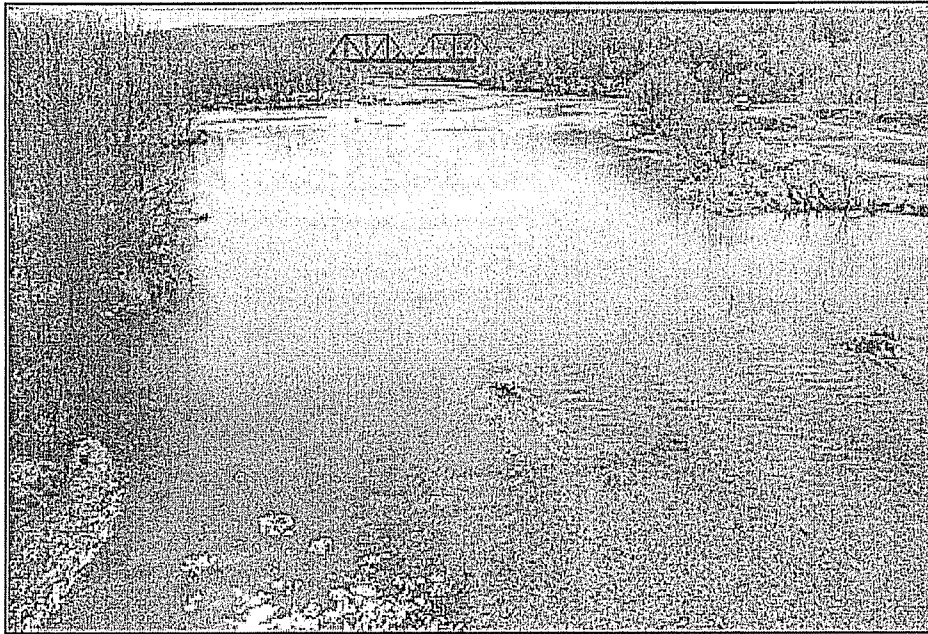


Figure B. Declining Water Clarity in the Illinois River Prompted Research and Protection Efforts.

valid or merely a manifestation of negative opinions concerning the blossoming poultry industry in the basin. Results indicated that there was cause for alarm; nutrient concentrations were high in the river and Lake Tenkiller and nutrient concentrations appeared to be increasing while clarity was decreasing. Data also revealed low dissolved oxygen and frequent algae blooms in the lake which indicated advancing eutrophication. Other studies revealed streambank erosion as a potential significant source of nutrients and sediment to the system. Overall, data indicated a decline in water quality which could translate into future loss of the river and Lake Tenkiller as a water supply, recreation, flood control, and biological resource.

Land use analysis correlated this decline in water quality to dramatic changes in land use in the basin. Agriculture increased substantially in the basin in the form of confined animal feeding operations (CAFOs), primarily poultry operations, and forest land continues to be cleared for pasture and hay production. Overall, these land use changes resulted in a net increase in the amount of nutrients entering the watershed (primarily through animal feed) without a concomitant increase in the amount being exported from the watershed. The resulting imbalance in the nutrient import/export cycle is manifested in the water quality of the basin.

However, agriculture cannot be cited as the sole source of water quality problems in the watershed. Other sources include point sources (pollution discharged by a large, stationary, identifiable sources such as wastewater treatment plants or factories) of

pollution which currently include only municipal discharges, but in the past have included industrial discharges, and various nonpoint (pollution from multiple, diffuse, poorly identifiable sources such as agricultural or urban runoff), and combined sources (pollution from both point and nonpoint sources) of pollution. Additional nonpoint sources include recreation, the remains of Lake Frances, urban runoff, gravel mining, and streambank erosion. Combined sources (sources with essentially both point and nonpoint source pollution) include nurseries and urban runoff.

POLLUTION SOURCES

Point Sources

Although point source discharges in Oklahoma did not account for the majority of the nutrient loading to the river and Lake Tenkiller, the load was significant enough to warrant reduction. Significant upgrades have already been implemented on point sources in Oklahoma due to efforts of the Oklahoma Department of Environmental Quality, Cities of Tahlequah and Stillwell, U.S. Environmental Protection Agency (EPA), and the unfortunate closing of the Stillwell Cannery. Combination and elimination of discharges has resulted or soon will result in 2 of the 3 remaining discharges undergoing tertiary treatment. These discharges have phosphorus limits (< 1 mg P/l) written into their permits. The result of these upgrades is a significant decrease in the point source load to the river. However, diligence towards reducing loads to the river must be maintained during operation of the plant to reduce likelihood of accidental spills and storm-related overflows of lagoons (Figure C).

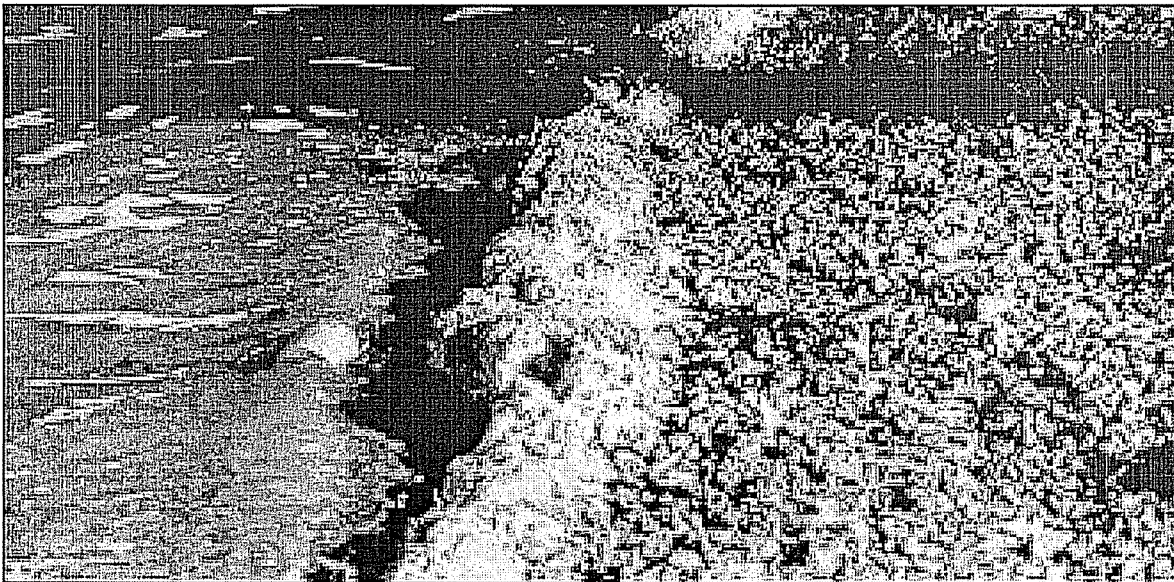


Figure C. Sewage Foam Below a Discharger Following an Accidental Discharge.

Nonpoint Sources

Recreation

The recreation industry has been a potentially significant source of pollution in the form of human waste and trash. Although the actual impact to water quality from the recreation industry is difficult to measure, it is not difficult to imagine the effects of over 400,000 river users and 1,500,000 lake users annually given the lack of restroom facilities and the visible trash left behind (**Figure D**). The recreation impact is likely more severe on the river than the lake due to the fact that an average 2,400 people per weekend float the river during peak months and until 1994 only one or two inadequately maintained toilet facilities were available.

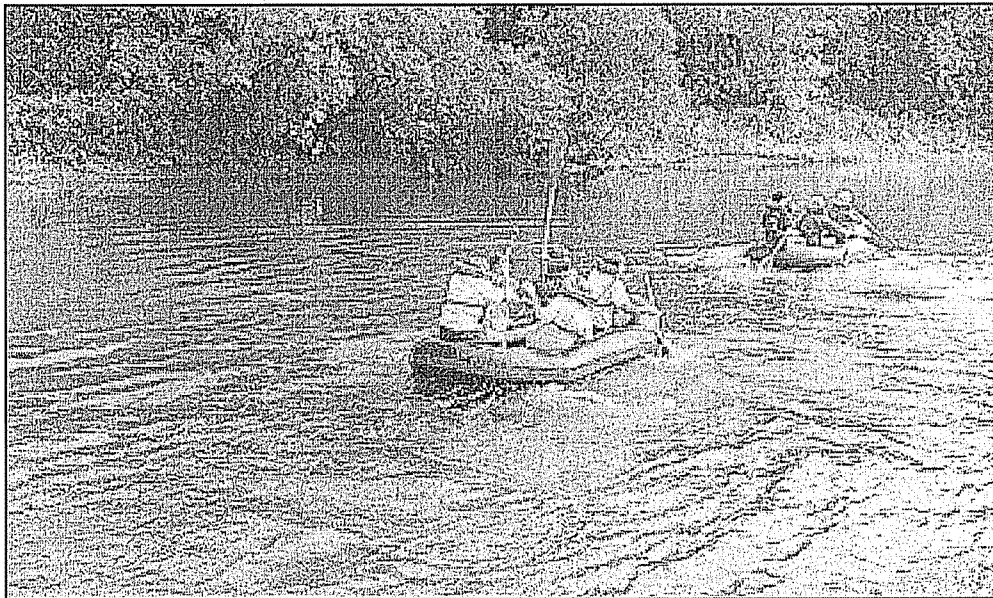


Figure D. The Illinois River Supports a Substantial Recreation Industry.

Recent projects conducted primarily by the Oklahoma Scenic Rivers Commission in cooperation with the Oklahoma Conservation Commission (OCC), Cherokee County Conservation District, and US EPA have resulted a dramatic increase in the quality and quantity of facilities available to river users. These improvements include canoer-only access areas complete with toilet, picnicing, and camping facilities, properly maintained pit and portable toilet facilities dispersed along the river route (cleaned out twice daily during peak season), and the provision of trashbags and trash collection points along the river route. This change has resulted in the removal of over 3,000 gallons of raw sewage from the canoer access area alone that would likely have otherwise reached the river. In addition, an estimated 110 - 120 tons of litter which may have otherwise remained in the river are removed annually due to the trashbag program.

Lake Frances

The collapse of the Lake Frances Dam in 1991 resulted in an additional source of nonpoint source pollution to the Illinois River basin in Oklahoma. The collapse exposed several hundred thousand cubic meters of nutrient-enriched lake bed to potential erosion. The primary concern is loss of sediment during storm events (**Figure E**). Although several options have been discussed concerning the former lake, including reconstruction of the dam and dredging the sediments, the streambed appears to be stabilizing itself and the best option may be to leave the system alone. The former lake bed now exhibits many of the characteristics of a wetland and if left alone to develop, may serve as a valuable nutrient sink and sediment filter to reduce downstream loadings the river and Lake Tenkiller.

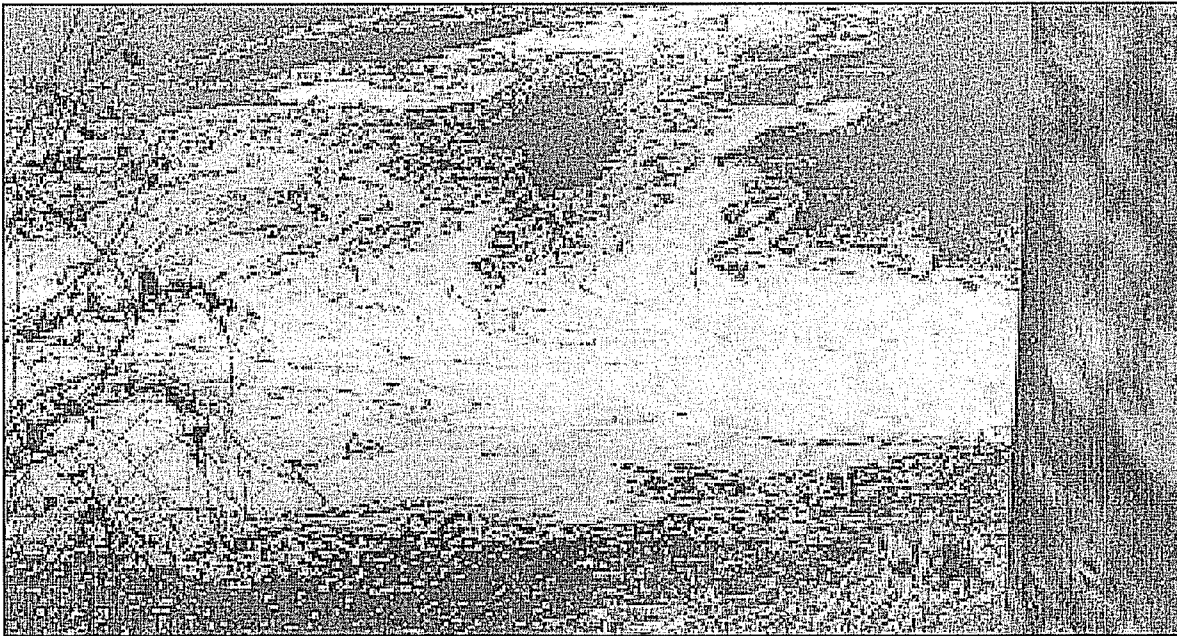


Figure E. Sediment-Laden Water Below Former Lake Frances After a Storm Event.

Animal Production Operations

Animal Production Operations provide the majority of agricultural income in the watershed and indeed are the largest industry in the basin (**Figure F**). Unfortunately, the influx of feed necessary to grow animals in such operations has resulted in an imbalance of the nutrient transport in the watershed. More nutrients enter the watershed in feed than leave the watershed in animal products. The result is that these left over nutrients, in the form of animal waste, are left in the watershed and ultimately make their way to the river and lake.



Figure F. Poultry Houses in Eastern Oklahoma.

A 1997 survey of confined animal operations in the watershed identified sites in the watershed, noted the number of houses present, and whether or not they were in production. Based on this survey and literature-supported estimates of nutrient production for various livestock, an estimated 13,256,000 lbs. of nitrogen and 4,284,800 lbs. of phosphorus are excreted annually by confined animals in the watershed. The survey also suggested that chickens produce 36% and 34%, turkeys produce 9% and 10%, dairy cattle produce 2% and 5%, hogs produce 9% and 10%, and beef cattle produce 44% and 41%, respectively of the nitrogen and phosphorus excreted in the watershed. These numbers suggest that although the poultry industry secrete a significant amount of nutrients, an even larger portion is secreted by beef cattle. This is important because beef cattle management is such that cattle often have direct access to streams. Thus, cattle may act as a point source and deposit the nutrients directly into the stream, while poultry waste accesses the stream mainly through overland flow. In addition, pasture management is not always optimal. Grazing land is scarce and pastures are often over grazed, resulting in poorer pasture with a lower capacity to process animal waste and prevent it from reaching the stream (**Figure G**).

Various solutions are available to reduce the impacts of this industry on water quality, ranging from reduction in animal numbers, installation of best management practices, and transport of wastes out of the basin. The installation of best management practices to reduce the transport of waste to the waterways is probably the best short-term approach. Mechanisms are in place to focus on this issue. The OCC will be devoting over 2 million

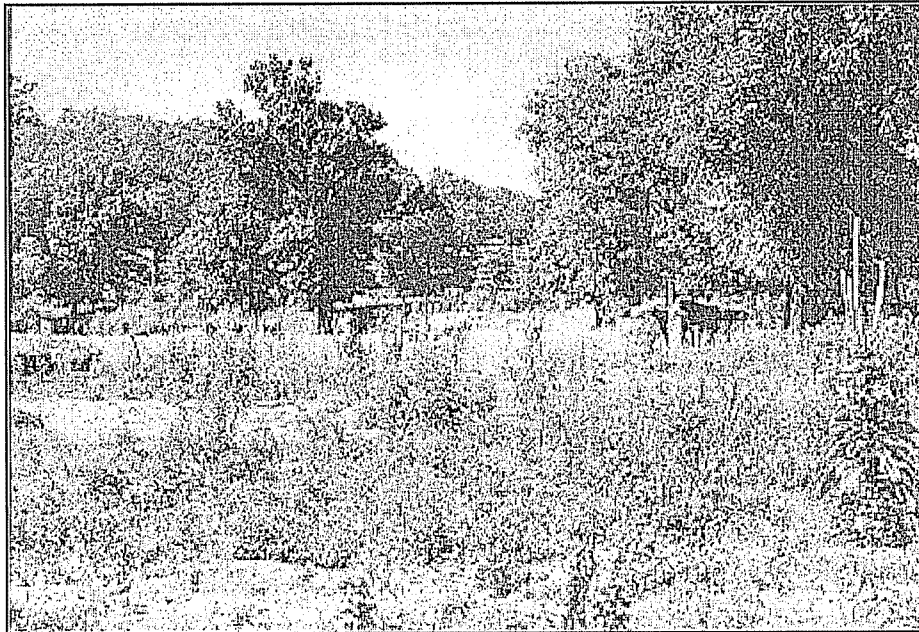


Figure G. Cattle Grazing in The Illinois River Watershed.

dollars between 1999 and 2004 to implement best management practices to reduce nutrient and sediment loading to the river. Many of these practices will help producers reduce the amount of waste reducing the river. This program is a cost-share program with required monetary or labor buy-in from the producer. The program will focus on areas where the concentration of pollution sources is the greatest. The assessment of need is based on water quality data, land use surveys, and locally-driven decision-making. A locally-led watershed advisory group (WAG) will be established to determine what kinds of practices will be available for cost-share funding and how the program should be administrated at a local level.

Waste transport out of the basin is being investigated as a future long-term solution. Transport costs are an issue as well as making sure that the waste is not being transported to an area where it will cause water quality problems.

On-Site Waste Disposal

The majority of the human population in the watershed relies on septic systems to dispose of residential wastes. 1990 census estimates suggest over 27,000 septic systems are in place in the 3 main Oklahoma counties of the watershed. Previous work in small subwatersheds in the basin (Battle Branch) suggested only about 25% of the on-site waste disposal systems met state requirements. These inadequacies range from insufficient lateral lines, lack or insufficient septic tanks, direct disposal of grey water to streams, ditches or land surfaces, and improperly located tanks and lateral lines. Extrapolation to

the whole watershed suggests the potential for 75% of rural households to have sub-standard systems. Although many well-maintained residences exist in the watershed, residences like those shown in **Figure H** are not uncommon.

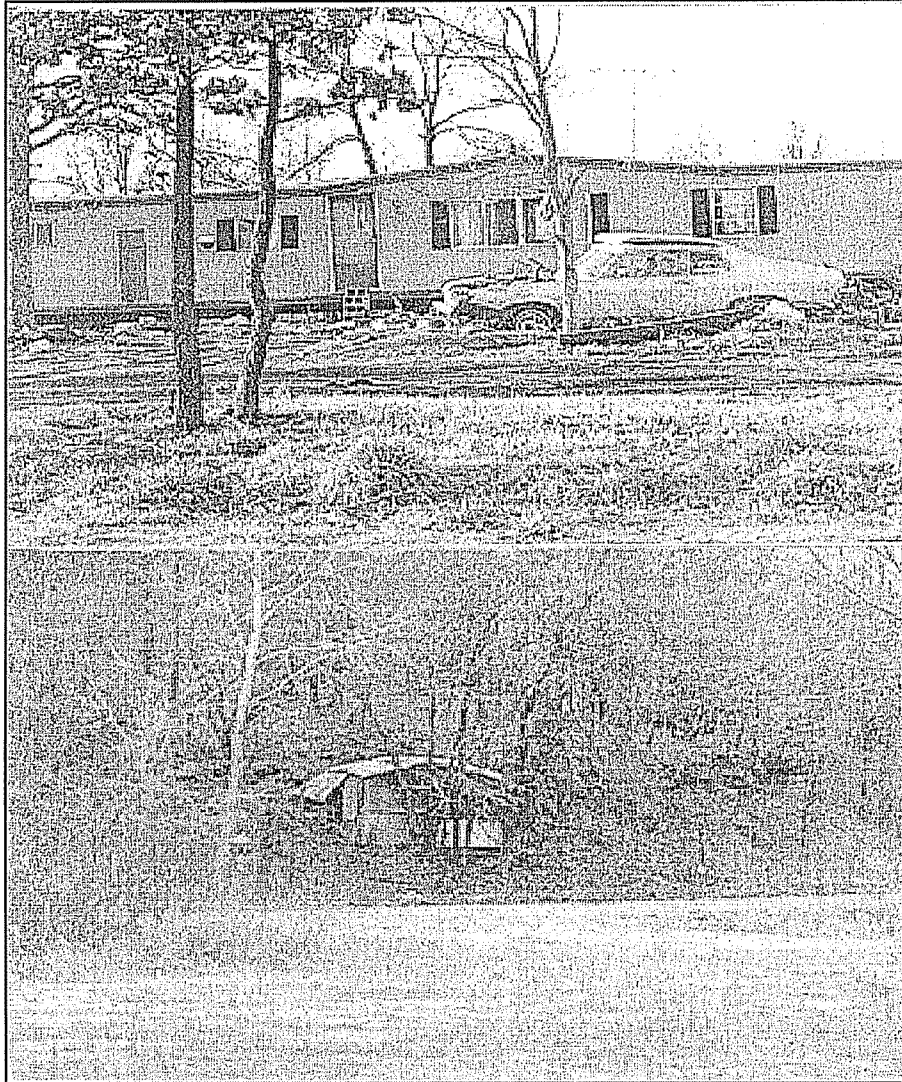


Figure H. Types of Residences in the Illinois River Watershed Which Typically Lack Adequate Septic Systems.

Solutions to the problems include connections to waste water treatment facilities or upgrading/installation of proper on-site waste disposal systems. The most cost-effective alternative is installation of or upgrading to proper on-site systems. This will require on-site investigation of current septic systems which will require additional personnel to those already in place with the Oklahoma Department of Environmental Quality (ODEQ) for that purpose. Cost of installation in the average residence varies between \$1500 and \$2500.

Probably the most feasible means to facilitate these installations is as part of an overall cost-share program to protect water quality administered through conservation districts.

Gravel Mining

In-stream and near-stream gravel mining threatens water quality and the overall aquatic community through exposure of bed load and stream banks to erosion. Recent investigation into the impact of gravel mining on the Baron Fork River revealed that mining activities had significantly impacted the riparian community and changed the morphology of the channel to an unstable configuration (Rosgen D classification) which is unlikely to restabilize itself without major structural modifications (OCC 1999). The resulting changes in stream morphology led to a wider, shallower, less stable stream (**Figure I**).



Figure I. Effects of Gravel Mining on The Baron Fork River.

Solutions to the problem range from restricting mining activities to training mine operators to regulating effluent water quality from mining operations. Training and regulations would require additional staff for Oklahoma Department of Mines and perhaps for Extension Service or Conservation Districts. The most feasible alternatives will probably involve more stringent limitations on the locations and extent of mining activities as well as training for mine operators to limit the impacts of their operations. Some site restoration operations may be necessary to repair damages already incurred.

Bank Erosion

Bank erosion along the Illinois River and its tributaries poses a substantial threat to the system. Eroding banks provide sediment, gravel, and nutrients which destroy valuable land, degrade water quality, destroy critical aquatic habitat, and eventually fill in Lake Tenkiller (**Figure J**). This bank erosion is often caused by elimination or poor maintenance of the riparian zone, bridge construction, upstream or downstream changes in channel morphology and/or various upstream land use changes. Estimates of the loading from bank material suggest that eroding banks contribute a significant amount of the total nutrient load in streams (OCC 1999).



Figure J. Bank Erosion in the Illinois River Watershed and Resulting Gravel Bars.

The most appropriate solution to this problem is to establish and protect riparian areas. This may or may not require fencing and restricted and/or limited use of near-stream areas, but protection of these areas will allow native vegetation to establish which is often the only protective measure necessary. Roots of native vegetation hold soil in place and protect against and dissipate the force of high flow events.

However, in some extreme cases, active restabilization work is necessary to protect the bank. The OCC has successfully completed several of these projects across the state, one of which is located on the Illinois River at Echota Bend. For less than half of the cost of conventional methods, bank stabilization measures were constructed using natural materials that restructured the channel as closely as possible to its natural configuration,

creating a system that was more equipped to withstand erosive pressure of high flows, but also protected landowners assets and provided better fish habitat.

Other Sources

A number of other nonpoint sources exist in the watershed which are not detailed in this report or plan. The reason for this omission is either due to insufficient ability to make estimates of the significance of these sources or known lack of significance considering the other nonpoint sources identified in this document. These other sources include but are not limited to wildlife, natural background loading due to geology and natural vegetation of the basin, illegal dumping (**Figure K**), and smaller livestock facilities such as people who keep a few head or horses or cattle.



Figure K. Illegal Dumpsites are an Additional Source of Nonpoint Source Pollution.

Although all of these other sources currently seem to be insignificant, reduction in the impacts from other sources may magnify the effects of these sources. Thus, it may be necessary to revisit and better define the magnitude of these sources once steps have been taken to reduce the impacts of known significant sources. In addition, education programs like those run by the OSRC and Cherokee County Conservation District are critical to reducing all types of nonpoint source pollution. Their goal is to provide citizens with an understanding of how pollutants reach the water, what types of effects they can have, and things people can do to reduce the impacts of pollution. Those education programs may be a significant tool towards reducing other minor sources.

Combined Sources

Urban Runoff

Urban runoff combines the effect of both point sources and nonpoint sources in that at times it contains pollution from point sources (in the form of overflows and system breaks) and overland flow. The urban areas in the Oklahoma portion of the watershed are small and thus likely produce only a small portion of the total pollutant load to the watershed (not counting discharged treated wastewater).

The most appropriate solution to the urban runoff solution is an education program targeted at providing urban dwellers with practices that reduce urban nonpoint source pollution. Coupled with this education program, stormwater permitting programs might be necessary to ensure the city planners and other appropriate entities incorporated nonpoint source pollution reduction into long-term goals.

The Cherokee County Conservation District and the Scenic Rivers Commission currently have education programs in place which provide citizens of the area with the knowledge to reduce Urban Nonpoint Source Pollution from their activities. The cities in the watershed are under the minimum size where stormwater permits are required. Should further research indicate urban stormwater runoff has a significant impact on the river, stormwater permits may be necessary in the future.

Nurseries

Two major nurseries are located along the Illinois River and one is located on the shores of Lake Tenkiller (**Figure L**). Irrigation tailwaters from the two largest nurseries have been shown to contribute significant quantities of nutrients to the basin. Oklahoma State Department of Agriculture estimates that one of the nurseries on the river contributed as much as 0.3% of the nitrate load and 0.19% of the yearly total phosphorus load to the river. The nursery on the shore of Lake Tenkiller was shown to contribute 1.95% of the total nitrate and 1.13% of the total phosphorus load to the lake. This loading was based on irrigation return flows and thus storm runoff from the nurseries was not even monitored. Stormwater runoff could have an even more significant impact.

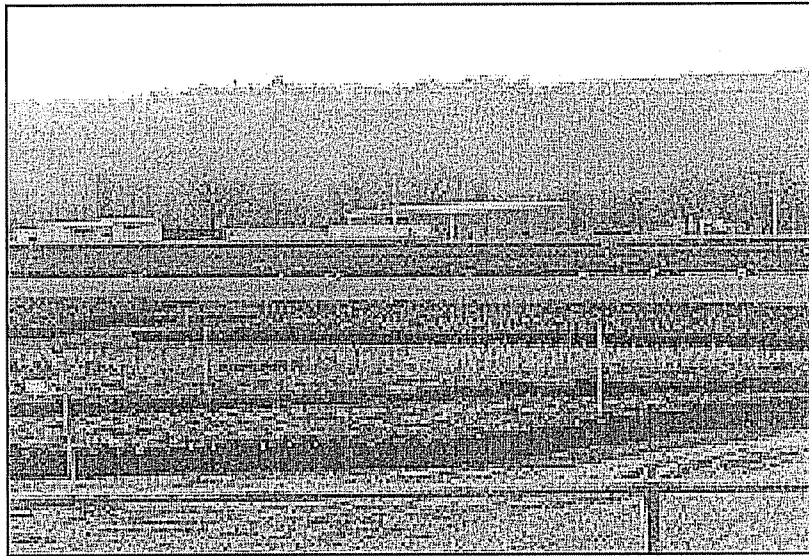


Figure L. Nursery in the Illinois River Watershed.

The most workable solution to limit pollution from nurseries is to capture, treat, and recirculate irrigation and stormwater runoff from the site rather than allowing it to flow into the river or lake. This is being implemented at the lakeshore nursery. Tailwaters are captured and recirculated through the irrigation system to create a total retention system. A pond was constructed for irrigation and much of the stormwater runoff to filter into. This pond serves as a holding and treatment basin for the tailwater. Testing of the water has revealed that it does not contain toxic levels of fertilizer or other plant hazards such as fungus. This total retention system will result in a significant decrease in the nutrient load from nurseries to the watershed.

EFFECTIVENESS OF NONPOINT SOURCE NUTRIENT CONTROL PROGRAMS

Control of nonpoint source pollution on a complete watershed basis has been completed on only one watershed in the Illinois River basin. Oklahoma's first 319(h) demonstration project was implemented between 1990-1993 in the Battle Branch watershed. Approximately \$100,000 worth of technical assistance, landowner contact, and BMP implementation over a 5970 acre watershed focused on practices aimed at reducing nutrient loading to Battle Branch Creek. This project "demonstrated" that BMPs could reduce nonpoint source pollution, but even more importantly, that the success of a nonpoint source pollution reduction program is based largely on the level of voluntary participation from the landowners. Approximately 84% of the landowners in the watershed participated in the project which was a significant factor behind its success.

Practices implemented included development and implementation of conservation plans,

waste management plans, installation of septic tanks, dairy lagoons, poultry composters, waste storage structures, and improved management of pastures, forest land, hayland including soil testing and tree planing. Implementation of these practices resulted in significant reductions in the nitrogen and phosphorus concentrations at baseflow and during runoff events in Battle Branch Creek at a cost of approximately \$16.75 per acre.

FUTURE PROGRAMS

One of the most critical future developments to protect the water resources of the basin will be the total maximum daily load (TMDL) currently being generated by the ODEQ. The TMDL will help appropriate an acceptable load between point and nonpoint sources. This acceptable load is one that will protect both the Illinois River and Lake Tenkiller for future use.

A critical part of the implementation of this TMDL is already underway in the form of a nonpoint source reduction program. Although the TMDL may require further point source reductions, the majority of load reduction necessary in Oklahoma will be through nonpoint source reductions.

The Oklahoma Conservation Commission has allocated significant funds toward a program to implement nonpoint source reductions in a cost-share program. Between 1999 and 2004, over 2 million dollars will go towards reducing nonpoint source pollution from various landuses in the basin. Many of these practices will focus on reducing the impact of animal waste on the basin; however, practices will also reduce streambank erosion, the impact of human waste, and the impact of various other human activities which affect water quality. Another critical component of the plan is the education component which will focus on educating the citizens and users of the watershed on the importance of water quality and practices which can be implemented to protect the aquatic resource.

This multi-million dollar effort will be directed through the activities of a watershed advisory group, made up of local decision makers and other concerned parties. They will offer assistance to land-owners on a cost-share basis to implement practices to protect water quality. The program will also monitor the affects of the program on the aquatic resources of the basin, in order to verify whether BMP installation improves water quality in the basin.

In conjunction with this program, several other programs are underway in the basin to reduce nutrient loading to the system. The Natural Resources Conservation Service will also focus funds towards cost-share assistance to reduce nonpoint source loading in the basin. The ODEQ continues to work with municipal dischargers and private citizens to reduce the impact of point sources and septic tanks to the system. The poultry industry is currently required by Oklahoma law to apply chicken litter on a soil phosphorus content ratio, rather than based on nitrogen needs or litter in need of disposal. This limitation should help focus phosphorus from chicken litter to areas of the watershed with lower soil

phosphorus and prevent the continued phosphorus saturation of soils in the basin. Education efforts by the Scenic Rivers Commission, local Conservation Districts, and other state education programs continue to focus on protecting the basin's natural resources.

In addition to the efforts previously described, the Scenic Rivers Commission has adopted a management plan to focus on protecting water quality within their area of jurisdiction (Illinois River between the Arkansas/Oklahoma State line and the headwaters of Lake Tenkiller). This plan includes specific goals toward reducing the nutrient load to the river and Lake from all potential sources. The plan also focuses on overall improvement of the resource, both from the standpoint of safety and resource quality.

COST OF REMEDIATION

The overall cost of remediating the problems in the Oklahoma portion of the Illinois River Watershed will be quite high and may be unrealistic, given the economic resources available. Thus, remediation efforts must focus in the most cost-effective manner. Thus, most of the future efforts should probably focus on reducing the impact to the watershed from animal production operations. Much is already being done to reduce nutrient impacts to the watershed and substantial funds have already been allocated towards reducing point source and nonpoint source loading. Additional funds necessary to protect the water resources may be difficult to estimate prior to the completion of the TMDL and before the success of currently planned programs to reduce nonpoint source pollution can be assessed.

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INTRODUCTION

ILLINOIS RIVER COMPREHENSIVE BASIN MANAGEMENT PLAN

The purpose of this document is to develop a comprehensive management plan for the Illinois River Basin in Oklahoma to devise a systematic approach to addressing pollution problems in the basin. Historically, most discussion of river problems have focused on single areas and it is hoped that this document will push the state towards a holistic view of problems within the basin. The State of Arkansas has developed a similar document for the portion of the basin within their state which will be combined with Oklahoma's plan to create a complete basin management plan. This report will attempt to incorporate efforts of other state agencies in the Illinois River basin. The Oklahoma Scenic Rivers Commission has developed a management plan for the river corridor (OSRC 1998). Although the OSRC plan pertains only to the river corridor (generally the land within 1/4 mile on either side of the river, includes the Illinois River from the Oklahoma state line downstream to the confluence with the Baron Fork, and its two major tributaries, Flint Creek and Baron Fork Creek), many of the ideas are applicable basin wide and this report will correlate with the OSRC plan. This report could be considered as part of the overall statewide nonpoint source management plan and as such could serve as a template for future work in other priority watersheds (The statewide nonpoint source management plan is subject to public review. Therefore, should the review process indicate that this document is not appropriate for inclusion in the statewide plan, it will not be included). This document should also provide foundation for the implementation of the nonpoint source portion of the Total Maximum Daily Load (TMDL) for the basin established by the Oklahoma Department of Environmental Quality (ODEQ).

This document is organized into several sections, each of which deals with a different river issue. The first section introduces the Illinois River, characterizing its location and statistics. The second section summarizes studies previously conducted within the river basin. This section is intended to familiarize those who are not aware of river problems with basic water quality issues. The third section covers the major sources of pollution along with an estimation of their contribution to river problems. This section also discusses potential solutions and costs.

The fourth section outlines the process of best management practice (BMP) implementation in small watersheds by detailing the results of the first implementation project in the basin. In the fifth section, future programs, both needed and planned are discussed. The final section summarizes the estimated costs for the different approaches to water pollution control.

This document should present an understanding of the complex problems within the basin and estimates of the costs of remediating those problems. Although it is relatively simple to estimate the costs of clean-up programs in terms of construction or implementation, it is very difficult to estimate other impacts. The reader is encouraged to consider the socio-economic impacts of such practices as reducing animal numbers or mandating waste control practices

on the citizens of the river basin.

For each of the pollution sources discussed, potential solutions are provided. It should be stressed that 'no action' is a viable alternative in all cases. The effect of this approach should be considered for all sources and weighed against the costs. It is unlikely that all sources of pollution within the basin can be eliminated; therefore, difficult decisions are necessary. Both long-term and short-term consequences should be analyzed for each area and weighed against others.

OKLAHOMA'S GOAL FOR THE ILLINOIS RIVER

The Illinois River and its tributaries are viewed as outstanding water resources for the purpose of their recreation, wildlife propagation, and aesthetic values. It is further recognized that the Illinois River and its tributaries are the primary sources of water for Tenkiller Ferry Reservoir, another outstanding water resource, and as such are directly responsible for reservoir water quality.

Oklahoma's goal is to maintain the quality of these water resources at the highest practical level by improving those practices which may contribute to water quality degradation. This will be accomplished through the identification and prioritization of problem areas followed by implementation of practices or procedures which will lessen the impact of individual sources to a practical minimum.

It is understood that the Illinois River and Tenkiller Ferry Reservoir have already experienced significant water quality deterioration as a result of both point and nonpoint sources of pollution and that specific contributors from both source categories must be addressed to prevent further degradation. Finally, it is recognized that significant improvements in river water quality must be accomplished if the river and reservoir are to remain classified as outstanding resource waters.

AREA DESCRIPTION

The Illinois River watershed straddles the Oklahoma/Arkansas border and of its 1,069,530 total acres, 576,030 (approximately 54% of the total basin area) are located in Oklahoma (USDA 1992). In Oklahoma, the watershed can be further sub-divided into 60 smaller watersheds ranging in size from 2382 to 31,046 acres with a mean size of 8825 (**Figure 1** & **Figure 2**). The basin is located in Delaware, Adair, Cherokee, and Sequoyah counties in northeastern Oklahoma.

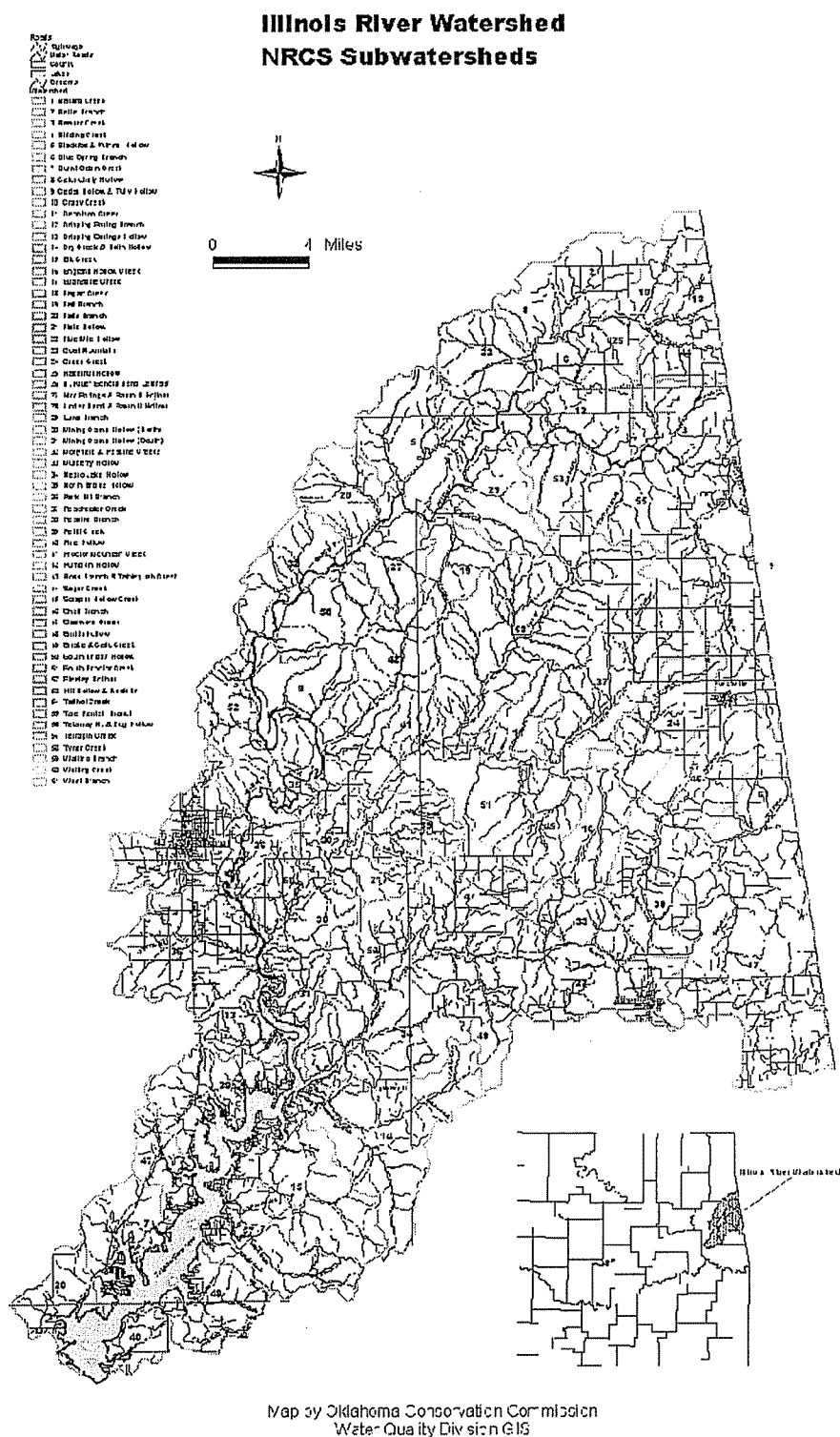


Figure 1. Map of Illinois River and major tributaries indicating approximate locations of subwatersheds.

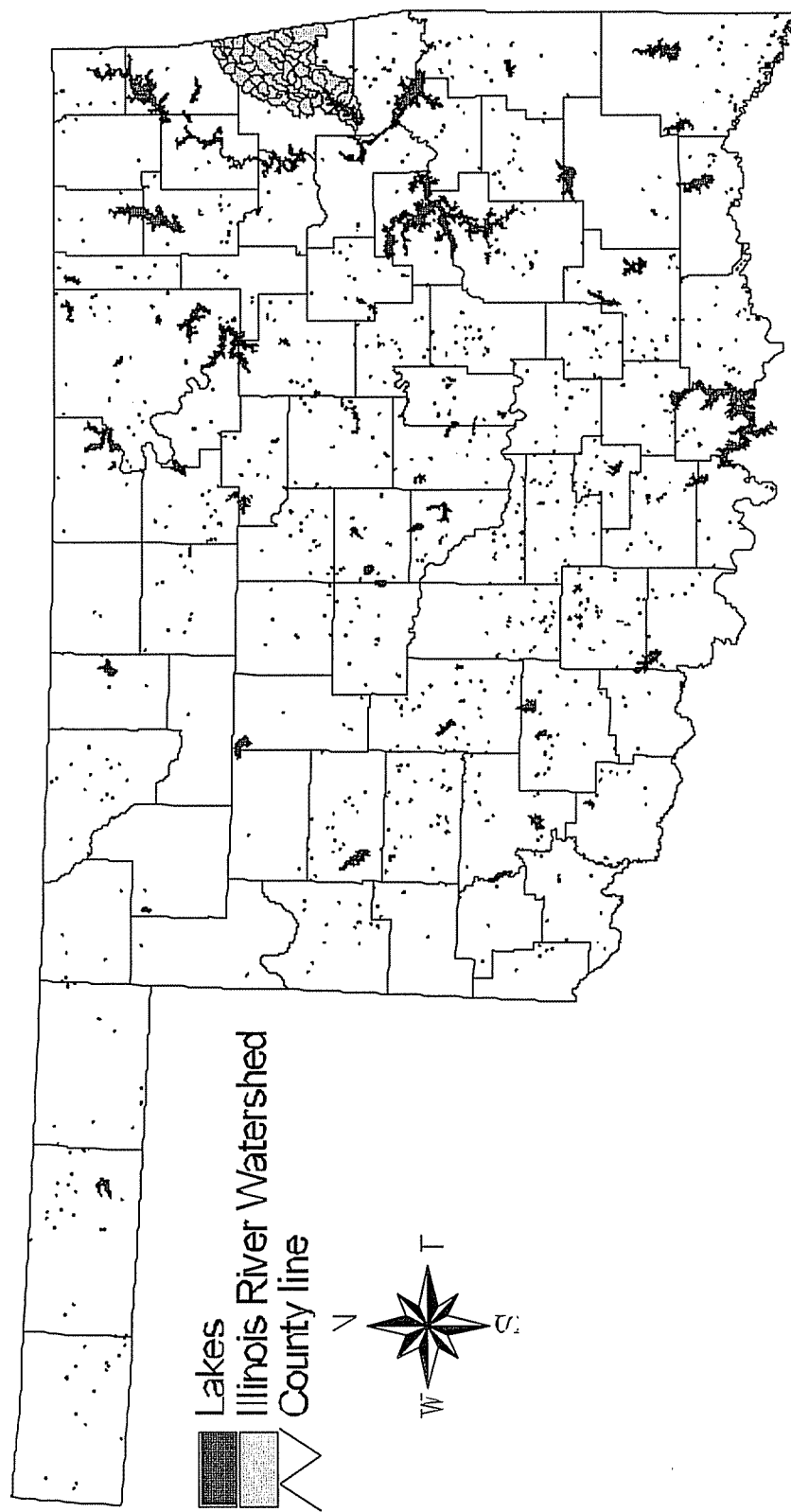


Figure 2. Location of Illinois River Watershed in Oklahoma.